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Description

MATERIAL SUPPORT SYSTEM FOR SUPPORTING ITEMS HAVING RADIO FREQUENCY IDENTIFICATION (RFID) TAGS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims the benefit of United States provisional application Serial No. 60/496,975, filed August 20, 2003, which is hereby incorporated herein by reference in its entity.

BACKGROUND OF INVENTION

[0002] The present invention is directed to a material support system for supporting items, such as individual items, for example, items being merchandised at a retail store, or the like. The invention may also be applied to containers of items, such as pallets or totes. The invention is applicable to a retail store merchandising system, namely, a system of retail store shelves, or the like. The invention is

also applicable to a warehouse material-handling system, such as an automatic storage and retrieval system, or the like.

[0003] Radio frequency identification (RFID) tags are used as a replacement for barcodes. RFID tags are capable of providing significantly greater information than barcodes and are capable of being read irrespective of the orientation of the item bearing the RFID tag. An RFID tag emits radio frequency signals containing information stored on the RFID tag when excited by an RFID reader. RFID readers typically operate to read the RFID tag as an item is transported past the stationary reader. Alternatively, the RFID reader may be a handheld device that is manually scanned past the item bearing the RFID tag.

SUMMARY OF INVENTION

[0004] The present invention provides a unique material support system which is capable of scanning RFID tags of a large number of items in the material support system in an automated manner. A material support system, according to an aspect of the invention, is provided for supporting items having RFID tags placed on the items. At least one item support is provided. Each of the at least one item support is adapted to support a horizontal row of items.

At least one radio frequency antenna is positioned adjacent the at least one item support. An antenna support system is provided. The antenna support system transports the at least one radio frequency antenna along the horizontal row of items at the at least one item support.

[0005] In one illustrated embodiment, the material support system is a retail store merchandising system. The at least one item support is a retail store shelf that is adapted to support individual items, each of the items bearing an RFID tag. Among a variety of functions, this allows the items on a store shelf to be inventoried, thereby maintaining an accurate inventory of the store's merchandise.

[0006] In another disclosed embodiment, the material support system is made up of a warehouse material-handling system. The at least one item support may be a row of container supports that are adapted to support multiple item containers. Each of the containers bears an RFID tag. Examples of such containers include totes, pallets, bins, shipping containers, and the like. The material support system in this embodiment may be an automatic storage and retrieval system. Such automatic storage and retrieval system includes a crane. The crane has a naturally traveling mast and a gripper that is vertically traveling along the

mast. The at least one radio frequency antenna may be positioned on the crane, such as on the gripper and/or on the mast. In this manner, as the crane travels along a storage rack, the RFID tags of the containers can be scanned. Alternatively, the antenna transport system may be a separate system adjacent the support rack opposite the crane. Other examples are disclosed of application of the invention to warehouse material-handling systems.

[0007] These and other objects, advantages and features of this invention will become apparent upon review of the following specification in conjunction with the drawings.

Brief Description of Drawings

[0008] Fig. 1 is a perspective view of a material support system, according to the invention;

[0009] Fig. 2 is an end elevation of the material support system in Fig. 1;

[0010] Fig. 3 is a perspective view of an RFID reading system including a radio frequency antenna array and antenna transport system;

[0011] Fig. 4 is the same view as Fig. 3 showing an alternative embodiment thereof;

[0012] Fig. 5 is the same view as Fig. 2 of an alternative embodiment of a material support system, according to the in-

vention; and

[0013] Fig. 6 is a side elevation of an alternative embodiment of a material support system, according to the invention.

Detailed Description of the Preferred Embodiment

[0014] Referring now specifically to the drawings, and the illustrative embodiments depicted therein, material support system 10 is for supporting items having radio frequency identification (RFID) tags placed on the items. Material support system 10 includes one or more item supports 12 for supporting horizontal rows of items 14 (Fig. 1). Material support system 10 additionally includes an RFID reading system 16 made up of one or more radio frequency (RF) antennas 18 and an antenna transport system 24 transporting the radio frequency antenna(s). In the embodiment illustrated in Figs. 1-4, item supports 12 are supported by vertical supports 22. The vertical supports 22, for back-to-back item supports 12 are illustrated as being spaced apart, thereby defining a void 24 between the vertical supports. RFID reading system 16 is positioned in void 24. In an alternative embodiment, a void may be defined within the item support and the RFID reading system positioned within the void. This is especially useful for new, rather than retrofit, material support

systems.

[0015] Antenna transport system 20 in the illustrated embodiment includes a rail 26 which, in the illustrative embodiment, may be an electrified monorail, or the like. Rail 26 may be attached to a vertical support 22 or may be supported by a pair of rail supports 28 or by other conventional supports. Antenna transport system 20 additionally includes a carriage 30 that is propelled along rail 26. In the embodiment illustrated in Fig. 3, a plurality of RF antennas 18 define an antenna array 32.

[0016] In operation, in order to read the RFID tags of items 14 on item supports 12, carriage 30 travels along rail 26. This causes each antenna 18 to be momentarily juxtaposed with the items at a particular location on the item support 12. As the carriage 30 moves along rail 26, the RFID tags are read on other items supported by item support 12, within reading range of an antenna 18. This process is repeated until carriage 30 moves the full length of rail 26 thereby having read all of the RFID tags of the items on item supports 12. The number of antennas 18 are selected according to the range of the antenna. The greater the range of the antenna, the fewer the number of antennas are required. Also, the shorter the range of the an-

tenna, the closer the antenna should be aligned with the associated item support 12. Indeed, if the range is sufficient on the antenna, it does not require an antenna for each item support 12. The data obtained by antenna array 32 may be transported to a collecting computer (not shown) utilizing known wireless communication techniques. Alternatively, rail 26 may support conductors which are contacted by carriage 30 as the carriage travels along the rail. Such electrified monorail systems are well known in the art. The electrified monorail system may supply power to a motor in carriage 30 in order to transport the carriage along rail 26. Alternatively, a system of cables and pulleys may be utilized to move carriage 30 from a stationary drive system. Operation of RFID reading system 16 may be under the control of an inventory management system which schedules the operation of the RFID reading system at desired intervals. Because the RFID reading system is positioned out of sight behind the item supports, it may be operated even during normal store hours. This is especially desirable for stores that are open 24 hours a day.

[0017] In the embodiment illustrated in Fig. 4, an RFID reading system 16' includes a carriage 30' having one or more

movable antennas 34 mounted thereto. Movable antenna 34 may transport vertically along carriage 30 and the carriage 30 is being transported horizontally along rail 26. This allows a fewer number of antennas to be utilized to read the RFID tags of items on all of the item supports 12.

[0018] A material support system 100 may be in the form of a warehouse management system. Warehouse management system 100 is made up of a plurality of item supports 102 which support containers, such as totes, shipping containers, pallets, and the like. Each such item 104 bears an RFID tag. Item supports 102 are also known as support racks and may be divided further into a series of individual recesses which are each capable of holding one item 104. Material support system 100 additionally includes a crane 140 for depositing items to and removing items from the item supports 102. Crane 140 includes a mast 142 which travels laterally along item supports 102. Crane 140 additionally includes a gripper assembly 144 which travels vertically along mast 142. As is well known in the art, such system also known as an automatic storage and retrieval system, is capable of storing containers at open positions along the item support 102 and retrieving desired containers from the item support.

[0019] As is best seen in Fig. 5, an RFID reading system 116 may be positioned between item supports 102 of a material support system 100. RFID reading system 116 may include the same components as reading systems 16, 16'. Item supports 102 may be supported by vertical supports 122 which may be in the form of individual steel numbers, support plates, or the like. Vertical supports 122 are spaced apart thereby defining a void in which reading system 116 is useable. In this manner, the antenna transport system may move the RF antenna(s) past the items 104 in a similar manner to that previously described.

[0020] In an alternative embodiment illustrated in Fig. 6, a material support system 100' includes an RFID reading system 116' in which the antenna transport system is defined by crane 140. In material support system 100', one or more antennas may be positioned on mast 142 and vertically positioned along the mast to read the RFID tags on the associated item support 102. In this manner, as the mast travels along the item supports, the RFID tags will be read. Alternatively, or in addition to, one or more RF antennas may be positioned at gripper assembly 144. This allows an RFID tag of a particular item to be read as when the gripper assembly is juxtaposed with the item. This infor-

mation may be used in association with information from the linear encoder that identifies the vertical height of the gripper assembly. This may be used to verify the identity of an item that is being retrieved from or stored to the item support 102. Alternatively, it may be used to take an inventory of the items on the transport system 100'. Other applications that may be apparent to the skilled artisan having been apprised of the present invention include the placement of an RF antenna at the forks of a fork truck or at the load support of an automated guided vehicle (AGV). This allows the RFID tag of a load to be read while it is being transported.

[0021] Changes and modifications in the specifically described embodiments can be carried out without departing from the principles of the invention which is intended to be limited only by the scope of the appended claims, as interpreted according to the principles of patent law including the doctrine of equivalents.